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# The impact of exchange rate development on Czech trade flows

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## Abstract

The aim of the paper is to investigate the impact of exchange rate development on bilateral trade flows between Czech Republic and its major trading partners. This paper explores J-curve pattern and relationship between exchange rate volatility and trade flows using quarterly data over the period 1997 – 2012. We employ a Johansen cointegration test to analyze the long run relationship. Short term effects are explored by estimating an error correction model and by assessing impulse-response functions. We reveal J-curve for trade with France and an inverse J-curve for Slovakia and United Kingdom. Volatility has no clear impact on trade flows.

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Keywords: exchange rate; international trade; J-curve

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## 1. Introduction

The relationship between currencies and trade has been the object of a wide policy debate since collapse of Bretton Woods's system. Transformation from fixed exchange rate regimes to free floating brought obvious volatility and uncertainty and this caused that early studies concerning this issue were focused especially on effects of exchange rates variability. The attention in mid2000's changed more towards the effects of exchange rate depreciation and misalignments, but global financial crisis, debt crises and subsequent central bank interventions increased exchange rate volatility again. There are numerous studies exploring these impacts, but

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their findings are mixed and depend on region and period under estimation as well as data and methodology used. This offers scope for examining both effects, the level of exchange rate and its volatility as well.

The aim of this paper is to explore the effects of exchange rate development on bilateral trade between Czech Republic and its major trading partners. Data used in this study covers period from 1997 to 2012.

Hence, this study provides additional evidence on the effect of exchange rate development on trade flows in the context of emerging market after the most turbulent part of economic transformation. The Czech Republic is an interesting subject for the study due to the fact that it is a small open economy, which ratio of foreign trade to GDP is still growing during the time. This is evidenced by the increase of the share of merchandise trade on GDP from 83.2% in 1997 to 144.6% according to the latest World Bank data. Usually, international trade tends to be a driver of the economy in countries neighboring with economies with open trade regimes, high presence of multinational companies and large volume of re-exports. Therefore Czech Republic is interesting objective to study because international trade serves as a major channel of its economic integration within the Group of Visegrad countries or the EU as a whole.

## **2. Theoretical framework and literature review**

Exchange rates may affect the international trade through two fundamental ways. First way is through their levels. According to Abeyasinghe and Yeak, 1998 policies prescriptions have generally assumed that currency depreciation stimulates exports and curtail imports, while currency appreciation is detrimental to exports and encourage imports. On the other hand, trade can be affected by exchange rate volatility, which is the source of exchange rates risk and has impact on the volume of international trade. Most current studies predict a negative relation between exchange rate risk, reflected in the conditional variance of the exchange rate, and export volumes (Barkoulas et al., 2002).

### *2.1. Relationship between exchange rate shifts and foreign trade*

After exchange rate change, there can be observed price and volume effects. Domestic currency depreciation (devaluation in fixed currency regimes) increases the price of imports in domestic currency terms, what means more expensive imports. Simultaneously it decreases the price of exports in foreign currency terms, other words exports become cheaper. Given the above, price effect of currency depreciation can increase the volume of exports and decrease volume of imports. However, one have to pay attention that currency depreciation is often connected with deterioration of the trade balance in the short run and improvement can be observable after few months. This is often explained under the J-curve effect.

J-curve theoretical basis itself comes from the Marshall-Lerner condition. This condition states that the sum of export and import demand elasticity has to be at least one and then the currency depreciation will have a positive impact on the trade balance. If the Marshall-Lerner condition is met, volume effect is higher than the price one. In general, it has been found that goods tend to be inelastic in the short run, as it takes time to change consuming patterns. In the long run, consumers can adjust to the new prices, and trade balance will improve. Short run effect of currency depreciation and related J-curve phenomenon was first advanced by Magee, 1973. He pointed that the short run deterioration and long run improvement of trade balance after depreciation resemble the letter “J” as it can be seen in Figure 1.

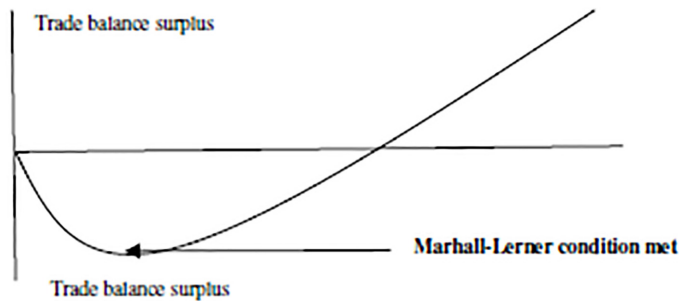


Fig.1 . J-curve pattern after currency depreciation

Depreciation deteriorates the trade balance initially, because it takes time to change consuming patterns. In the long run, consumers can adjust to the new prices, and trade balance will improve. Junz and Rhomberg, 1973 has attributed the J-curve phenomenon to five types of lags; in the recognition of exchange rate changes, in the decision to changes of real variables, in delivery time, in the replacement of inventories and materials, and in production. Krueger, 1983 has explained the phenomenon by the fact that at the time when exchange rate change occurs, goods already in transit and under contract has been purchased, and the completion of those transactions dominates the short run change in the trade balance.

Despite of numerous J-curve studies, just few of them are focused on Central and Eastern European countries, including Czech Republic. Using generalized impulse response functions, Hacker and Hatemi, 2004 tested the J-curve for three transitional Central European countries (Czech Republic, Hungary, and Poland) in their bilateral trade with respect to Germany. Their findings suggest that for Czech Republic, there are some characteristics associated with a J-curve effect. After a real or nominal depreciation trade balance briefly drops to below its initial value within a few months and then rises to a long run equilibrium value higher than the initial one.

An extensive study for emerging Europe (Bulgaria, Croatia, Cyprus, Czech Republic, Hungary, Poland, Romania, Russia, Slovakia, Turkey and Ukraine) was written by Bahmani-Oskooee and Kutun, 2009. They used monthly data over the period January 1990 and June 2005 and applied conditional autoregressive distributed lag cointegration approach and corresponding error correction model. They found empirical support for the J-curve effect in Bulgaria, Croatia and Russia. In Czech Republic, they did not find out any characteristics or signs of the J-curve effect existence. Hsing, 2009 examined the J-curve for bilateral trade between Croatia, Czech Republic, Hungary, Poland, Slovakia, Slovenia and the USA. This paper came to conclusion that the J-curve is not empirically confirmed for any of these six countries. The newest study by Nusair, 2013 tested the J-curve phenomenon for seventeen transition economies using monthly data over the period 1991 to 2012. For this purpose he used conditional autoregressive distributed lag bounds cointegration approach and error correction modelling. He used aggregated data and real effective exchange rate. The results suggest evidence the J-curve phenomenon support for Armenia, Georgia and Ukraine, but no for Czech Republic.

As can be seen, studies focused on Czech Republic and its relationship between exxchange rate and trade balance are very limited, but according to OECD, 2011 can be stated that small economies trade tends to be more impacted by exchange rate changes than larger economies. This finding is consistent with earlier theoretical and empirical literature. One reason is that smaller economies have less a diversified production and export base, and hence are less in a position to move into exports that have greater price elasticity, when exchange rate appreciation results in potentially more costly exports.

## 2.2. Relationship between exchange rate volatility and foreign trade

Despite recent research has shifted away from the effects on trade of exchange volatility towards the effects of exchange rate depreciation, debate about exchange rate movements and their impact on trade balances rebounded in the aftermath of the crisis and therefore is appropriate to complement examining the effect of the level of the exchange rate by its impact through volatility.

Generally was assumed, that higher exchange rate volatility leads to higher transaction costs for traders and is followed by decrease of foreign trade. Theoretical analyses of the relationship have been conducted by Hooper and Kohlhagen, 1978 who argue, that if changes in exchange rates are unpredictable it means uncertainty about companies' profits and reduces the benefits of foreign trade. Even if hedging in the forward markets were possible, there are limitations and costs, especially considerable for small firms. According to latest studies made by Taglioni, 2002 and Ozturk, 2006, it can be stated, that the adverse effect of exchange rate volatility on trade flows, if it exists, is not large. On the other hand, De Grauwe, 1988 stressed that the dominance of income effects over substitution effects can lead to a positive relationship between trade and nominal exchange rate volatility. This is because, if exporters are sufficiently risk averse, an increase in exchange rate volatility raises the expected marginal utility of export revenue and therefore induces them to increase exports.

Recent studies confirm the fact that there are situations in which the volatility of exchange rates could be expected to have either negative or positive effects on trade volume. This is caused by selection of region, country and period under estimation as well as data and methodology used. In the IMF's study, 2004 on exchange rate volatility and trade flows can be found conclusion that there is no obvious negative relationship between aggregate exchange rate volatility and aggregate trade. When the research is turned to bilateral trade, we do find evidence that exchange rate volatility seems to more affect bilateral trade than the aggregate one. Given the above, evidence on the researched relationship is best characterized as mixed as the results are sensitive to the choices of sample period, model specification, proxies for exchange rate volatility and countries.

In summary, the existing empirical literature on the relationship between exchange rate and trade flows concerning Czech Republic is very limited. Results of the few previously published studies indicate almost no evidence for the J-curve effect. Therefore, this study substantially contributes to scientific discussion in this field and fills the gap in literature. As compared to other papers we use the most recent available data on bilateral trade with the largest partners, we distinguish invoicing currencies where applicable and we employ cointegration approach and corresponding error correction modelling with impulse response functions. To extend the empirical finding we investigate effect of exchange rate volatility as well. For this purpose we use GARCH model to estimate variability and again cointegration procedure to investigate its impact on import and export flows.

## 3. Model specification

The consensus among all recent studies is that the bilateral trade balance should depend on domestic income, income of a trading partner and bilateral exchange rate. In order to detect the long term co-movement among the variables, the cointegration procedure developed by Johansen, 1997 is used. This avoids the main criticism of early studies, whose results could suffer from regression problem because of non-stationary data. Thus, following Bahmani-Oskooee and Kutun, 2009, equation (1) is adopted in empirical modelling of the J-curve effect:

$$\ln TB_t = \alpha + \beta \ln Y_{d,t} + \gamma \ln Y_{f,t} + \lambda \ln ER_t + \varepsilon_t \quad (1)$$

where  $TB$  is a measure of trade balance in time period  $t$  defined as the ratio of exports of Czech Republic to country  $f$  to Czech Republic's imports from country  $f$ . Hence, the model could be expressed in log-linear form.  $Y_d$  is measure of the Czech Republic's income set in index form to make it unit free (Bahmani-Oskoei, 1991);  $Y_f$  is the index of income in trading partner  $f$  and  $ER$  is the nominal bilateral exchange rate between the Czech koruna and the currency of trading partner  $f$ . The nominal exchange rate was chosen, as nominal and real exchange rates tend to move closely together and the choice is not likely to the econometric results (Auboin and Rutha, 2012).

The above defined trade balance model represents the long run relationships between the trade balance and its determinants. To test the J-curve phenomenon in short run, a short term dynamics must be incorporated into the long run model. According to Hsing, 2009 we apply the following modified error correction model:

$$\Delta \ln TB_t = \alpha + \sum_{i=1}^n \omega_i \Delta \ln TB_{t-i} + \sum_{i=1}^n \beta_i \Delta \ln Y_{d,t-i} + \sum_{i=1}^n \gamma_i \Delta \ln Y_{f,t-i} + \sum_{i=1}^n \lambda_i \Delta \ln ER_{t-i} \quad (2)$$

To investigate the impact of exchange rate volatility on import and export flows we follow Bakhromov, 2011. Fundamental economic theory suggests that foreign income has a substantial impact on domestic exports, so that an increase in foreign income will result to an increase in the demand for domestic exports. On the other hand, exchange rate volatility will have a negative relationship on it. Variables such as domestic income and volatility have a major impact on the import function. The level of bilateral exchange rates in models prevails again. We use the following log-linear equations:

$$\ln(X_t) = \alpha + \beta \ln(Y_{f,t}) + \lambda \ln(V_t) + \varepsilon_t \quad (3)$$

$$\ln(M_t) = \alpha + \beta \ln(Y_{d,t}) + \lambda \ln(V_t) + \varepsilon_t \quad (4)$$

where  $\ln X_t$  is the logarithm of exports from Czech Republic to its trading partner,  $\ln M_t$  is the logarithm of imports to Czech Republic from its trading partner,  $\ln V_t$  is a measure of exchange rate volatility. To measure the exchange rate volatility in this paper is used GARCH model. It models the variance of the disturbance term for each period as a function of the errors in the previous periods.

#### 4. Empirical results

This section reports the estimates of the effects of exchange rates for Czech Republic and its major trading partners: Austria, France, Germany, Italy, Netherlands, Poland, Slovak Republic and United Kingdom. The models are estimated by using quarterly data over the period 1997:1 – 2012:2. All data are obtained from the OECD iLibrary statistical database. The data are in current prices and denominated in the USD. The countries selection is based on the share on total international trade turnover.

Before conducting necessary tests and empirical estimations, the time series used in the analysis are adjusted by a logarithmic transformation. This helps to reduce skewness and heteroscedasticity and to stabilize variability. Before estimation of the co integration parameters, the order of integration for each time series should be examined. Integration is determined using the augmented Dickey-Fuller (ADF) test recommended by Engle and Granger, 1987. The ADF test for each individual time series confirmed the presence of unit roots, i.e. the first-difference stationary was found for all variables. According to Balke and Fomby (1997), non-stationary on levels is the basic precondition of co integration between variables.

Since the choice of the lag orders of the variables in the vector error correction model specification can have a significant effect on the inference drawn from the model, another step of analysis we sequentially determine the appropriate lag length for each variable by using Akaike Information Criterion and Schwarz Bayesian

Criterion. In general there is no agreement on which criterion is better, but in case of different results for optimal lag we prefer Schwarz-Bayesian criterion, which is more consistent.

When the optimal lag order is determined, we can perform cointegration analysis and test existence of a stable long run equilibrium between non-stationary variables. If the variables are found to cointegrate (parameters are stable), the final step in the analysis is estimation of the vector error correction model to generate the impulse response functions and to construct the J-curves. We proceed to examine the dynamic responses by generating impulse response functions showing the response of the trade balance to the Czech koruna depreciation. As indicated before, the short run effects of depreciation are reflected in the coefficient estimates obtained for the lagged value of the first differenced exchange rate variable. The J-curve phenomenon should be supported by negative coefficients followed by positive ones.

Note the paper considers the role of invoicing currency. Very often trade between a pair of countries is not invoiced in the currency of either country, but in some world currency. In the case of Czech Republic it is mainly euro. If euro is in some case a functional currency, the volatility of the exchange rate between the currencies of the two trading partners is not relevant to consider.

observed. In case of Germany, the results are similar to those of Hacker and Hatemi, 2004. One can find some features of the J-curve effect in the obtained results. The initial deterioration of the Czech Republic's trade balance lasts two quarter and subsequently, a partial improvement of bilateral trade balance occurs.

Depreciation of the Czech koruna is accompanied by improvement of Czech Republic's bilateral trade balance with Netherlands. The initial improvement lasting three quarters can be observed in trading flows with Slovakia and United Kingdom with invoicing currency British pounds. When we use for trading euro instead of pounds, improvement lasts only 2 quarters. One can state, there is revealed an inverse J-curve.

In bilateral trade balance with Austria, Italy and Poland, there can be observed a cyclical pattern. In case of Austria and Italy, first improvement lasts two quarters, but following deterioration is higher in trading flows with Italy. As already mentioned, we distinguish Czech Republic's trade with the Poland and United Kingdom into trades denominated in the euro and trades in the Polish zloty and British pound respectively. The respective impulse response functions for trade with Poland shows different development of trade balance for different invoicing currencies. As it is evident from Figure 2, there is significant difference and, hence, the effect of depreciation is dependent on the invoicing currency in bilateral trade flows with Poland. More appropriate invoicing currency is in this case euro.

Table 1 Estimated effects of exchange rate volatility

Trading partner	Export	Import
Austria	13.68	6.32
France	-6.54	4.11
Germany	-4.4	8.87
Italy	2.07	6.31
Netherlands	13.34	8.07
Poland	-19.19	7.96
Slovakia	-8.24	-9.18
United Kingdom	-11.30	-9.24

The empirical results presented in Table 1 indicate that impact of exchange rate volatility on bilateral trade flows is again mixed. The expected negative effects are confirmed in case of Slovak Republic and United Kingdom. On the other hand, higher volatility of Czech koruna causes decreasing of import and export flows between Czech Republic and Austria, Italy and Netherlands. The worst impact of volatility is in case of France, Germany and Poland. Higher volatility causes decreasing of exports and increasing of imports from respective countries.

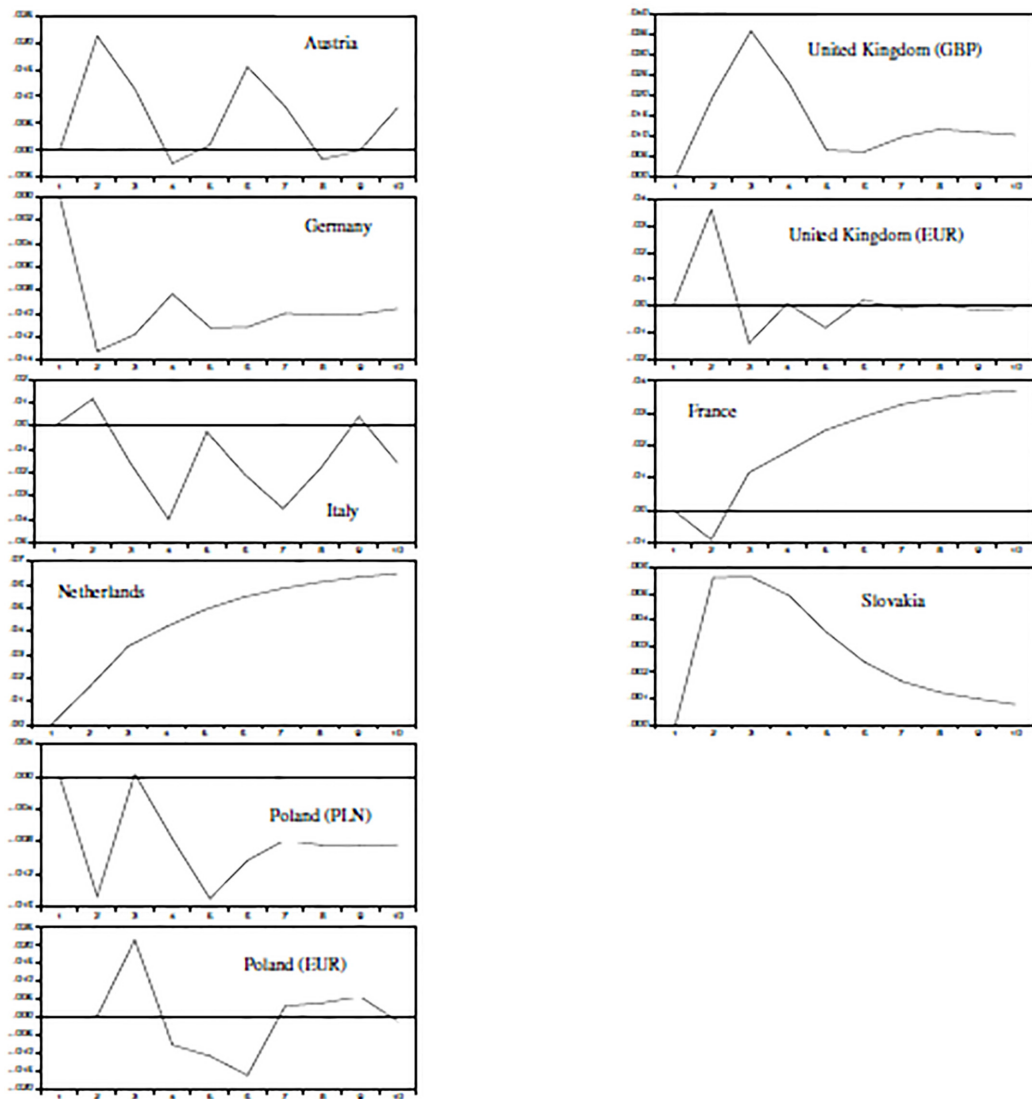


Fig 2 Bilateral J-curves of Czech Republic

Graphical representations of the impulse response functions do present only one typical J-curve, for trade with France. For the Czech Republic's trading flows with Germany just partial bilateral J-curve effect can be

## 5. Conclusion

The aim of the paper was to investigate the impact of exchange rate development on bilateral export and import flows between Czech Republic and its major trading partners. We included eight largest trading partners into the analysis and the results suggest that effect of depreciation of the Czech koruna is usually weak and its direction differs across the countries. We revealed that depreciation of the local currency is



accompanied by J-curve pattern of the Czech Republic's trade balance with France. A partial J-curve effect can be observed in case of Czech trading flows with Germany. By contrast, an inverse J-curve was uncovered for trades between Czech Republic and the United Kingdom and Slovakia. For other trading partners the results are mixed and can not be generalized. In this paper was not detected any clear results for relationship between volatility of Czech koruna and bilateral trading flows which can be uniformed for whole foreign trade of Czech Republic. Therefore, the results indicate that an active exchange rate policy aimed to influence exchange rate development is not supposed to promote any notable improvement of trade balance. Thus, development of the Czech Republic's international trade seems to be affected by other factors than development of exchange rates.

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